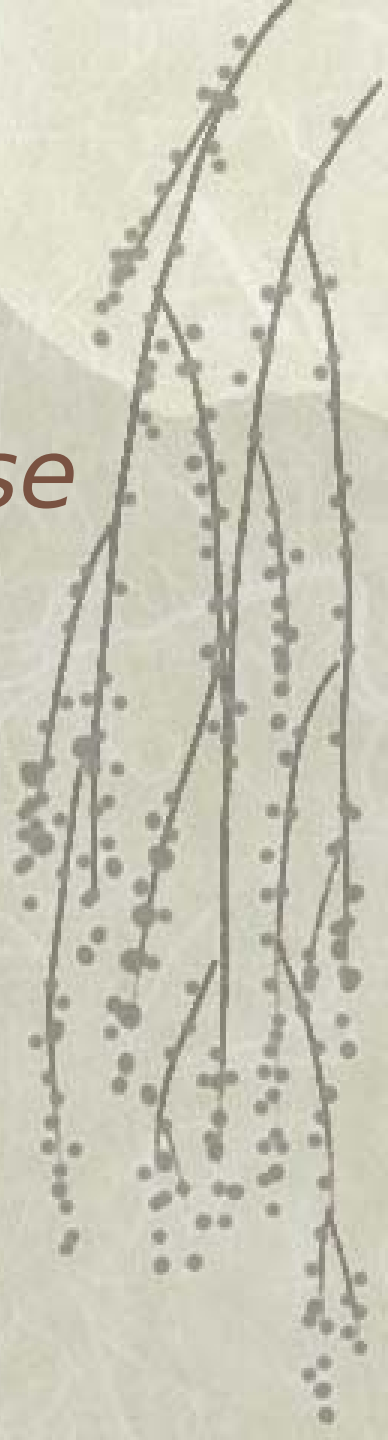
Sustainable Sites

SPiRiT and SDD Training Course



Site Issues

Site issues fall into several categories:

- ✓ Site selection
- ✓ Site disturbance and runoff
- ✓ Alternative transportation
- ✓ Heat island and light pollution

Site opportunities vary considerably, but ecological enhancement is generally an available option. This especially applies to campus and large development sites.

SPiRiT has 1 prerequisite and 11 credits on Sustainable Sites for a total of 20 points.

Sustainable Sites

Erosion and Sedimentation Control - Required

INTENT:

Control erosion to reduce negative impacts on water and air quality.

A Slack Job Here

Way To Go!

Sustainable Sites

Erosion and Sedimentation Control - Required

REQUIREMENT:

Design to a site sediment and erosion control plan that conforms to best management practices in the EPA's Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices, EPA Document No. EPA-832-R-92-005, OR local Erosion and Sedimentation Control standards and codes, whichever is more stringent. The plan shall meet the following objectives:

Sustainable Sites

Erosion and Sedimentation Control - Required

Requirement (continued):

- Prevent loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.
- Prevent sedimentation of storm sewer or receiving streams and/or air pollution with dust and particulate matter.

Sustainable Sites
Erosion and Sedimentation Control - Required

TECHNOLOGIES/STRATEGIES:

The EPA standard lists numerous measures such as silt fencing, sediment traps, construction phasing, stabilization of steep slopes, maintaining vegetated ground cover and providing ground cover that will meet this prerequisite.

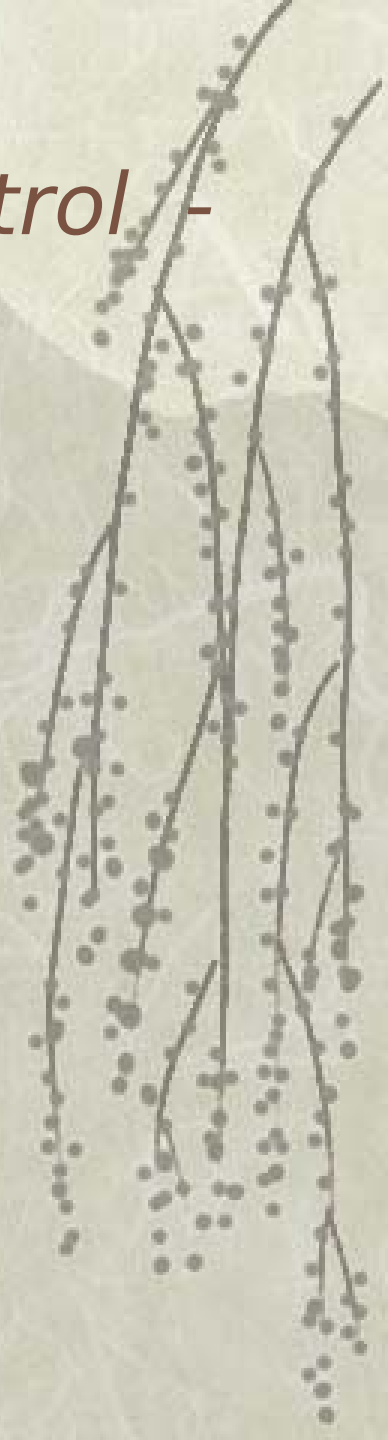
Geotextile mats not only protect ground surfaces from wind and storm water erosion but also allow vegetative growth (Source: Rolanka International, 2000)

Sediment traps are used to collect sediment-laden runoff from disturbed areas on construction sites

Sustainable Sites

Erosion and Sedimentation Control - Required

EPA has many documents on-line and easy to download: http://cfpub1.epa.gov/npdes/stormwater/swphase2.cfm?program_id=6



Sustainable Sites

Site Selection - 1-2 Credits

INTENT:

Avoid development of inappropriate sites and reduce the environmental impact from the location of a building on a site. Select site based on functional adjacencies/relationships and land use compatibility.

REQUIREMENTS:

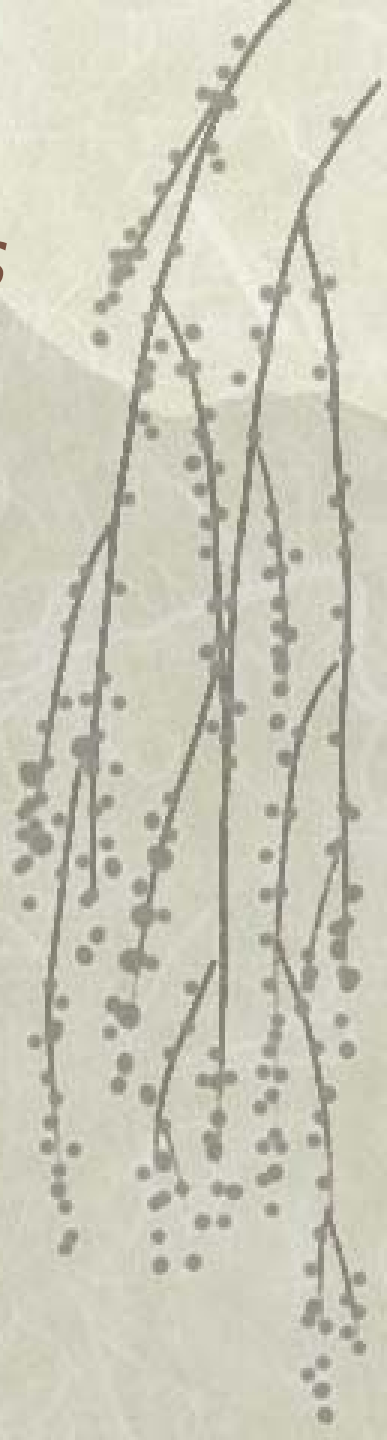
Do not develop buildings on portions of sites that meet any one of the following criteria (1 point):

- Prime training or maneuver land.

Sustainable Sites
Site Selection - 1-2 Credits

REQUIREMENTS (cont):

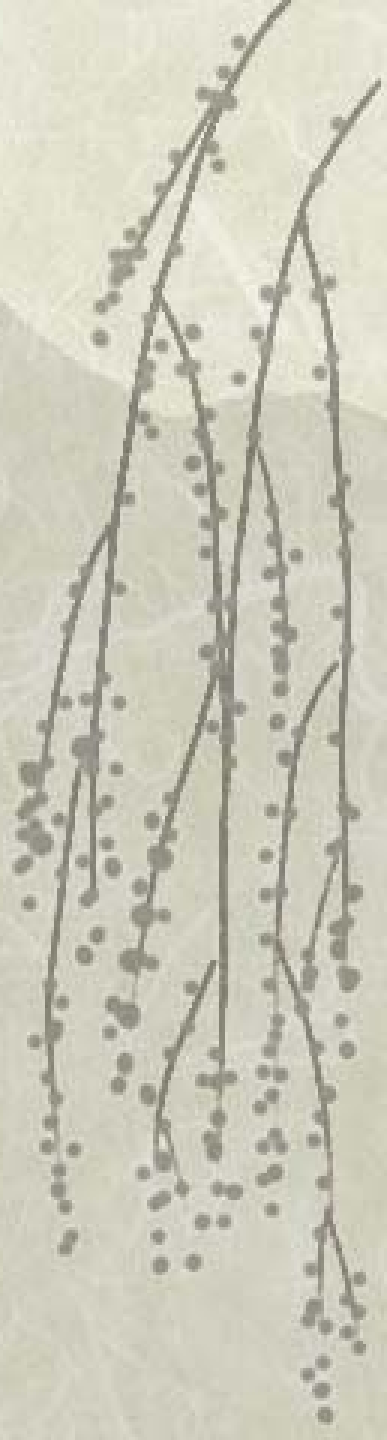
- Land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA.
- Land that provides habitat for any species on the Federal or State threatened or endangered list.
- Within 100 feet of any wetland as defined by 40 CFR, Parts 230-233 and Part 22, OR as defined by local or state rule or law, whichever is more stringent.



Sustainable Sites
Site Selection - 1-2 Credits

Select site based on functional adjacencies/ relationships and land use compatibility (1 point).

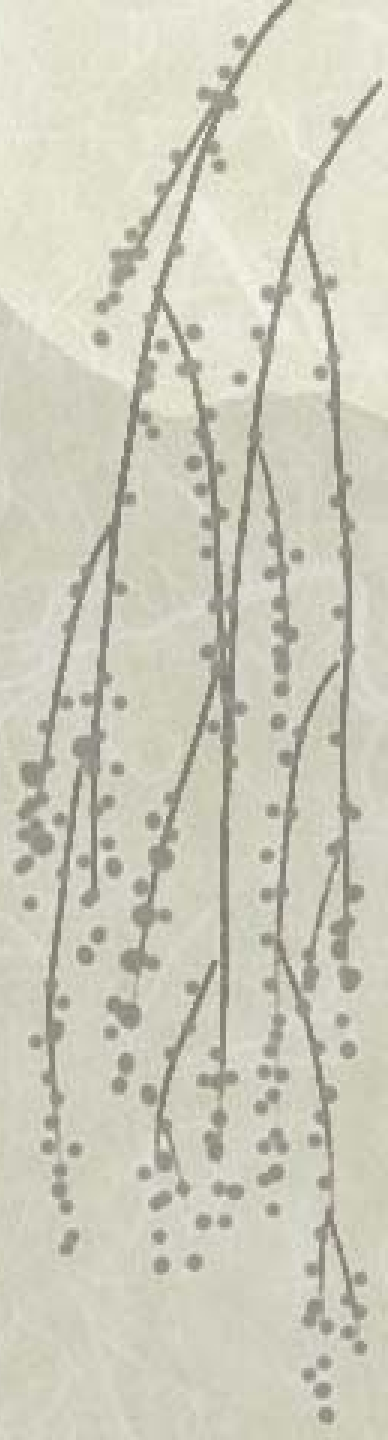
- Select sites close to existing roads and utilities or use an existing structure to minimize the need for new infrastructure.
- Select site in area of high density.
- Site facilities based on the strength of their relationships to other facilities/land-uses to limit travel distances. The stronger the relationship/ functional interaction, the closer the distance between two facilities.



Sustainable Sites
Site Selection - 1-2 Credits

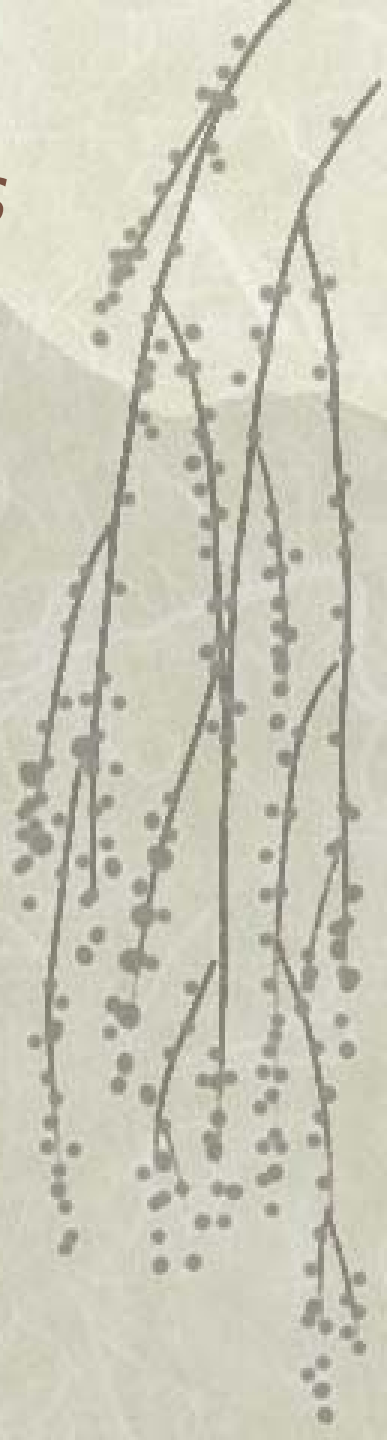
Select site based on functional adjacencies/ relationships and land use compatibility (cont).

- Select for distance to installation/base transit systems and access to pedestrian ways and bike paths.
- Select for development previously used or developed suitable and available sites.



Sustainable Sites

Site Selection - 1-2 Credits

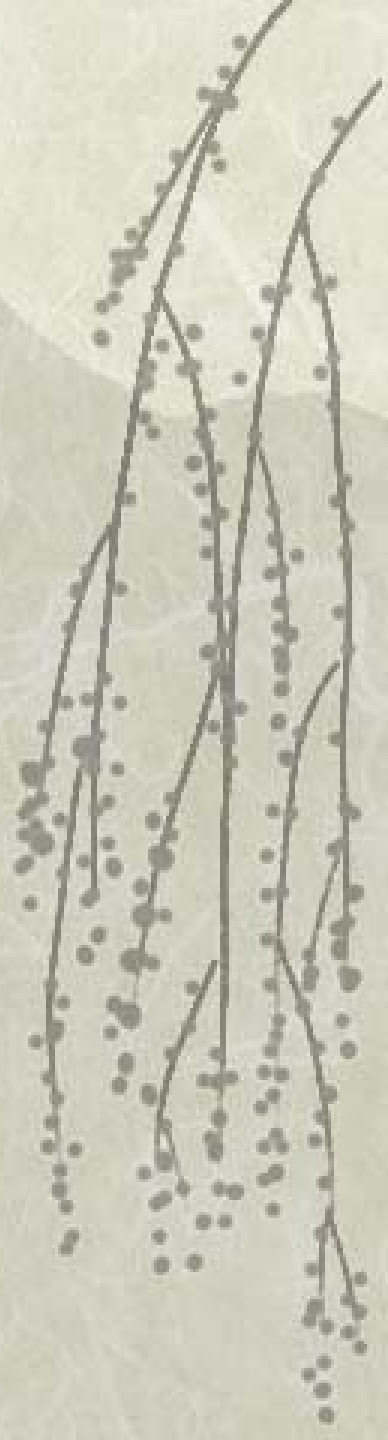


TECHNOLOGIES/STRATEGIES:

Screen potential building sites for these criteria and/or ensure that these criteria are addressed by the designer during the concept design stage. Utilize landscape architects, ecologists, environmental engineers, civil engineers, and similar professionals for the screening process. New wetlands constructed as part of stormwater mitigation or other site restoration efforts are not affected by the restrictions of this credit.

Sustainable Sites

Installation Base Redevelopment - 1-2 Credits



INTENT:

Channel development to installation/base cantonment areas with existing infrastructure, protecting greenfields and preserving habitat and natural resources.

REQUIREMENTS:

Increase localized density to conform to existing or desired density goals by utilizing sites that are located within existing cantonment areas of high development density (1 Point).

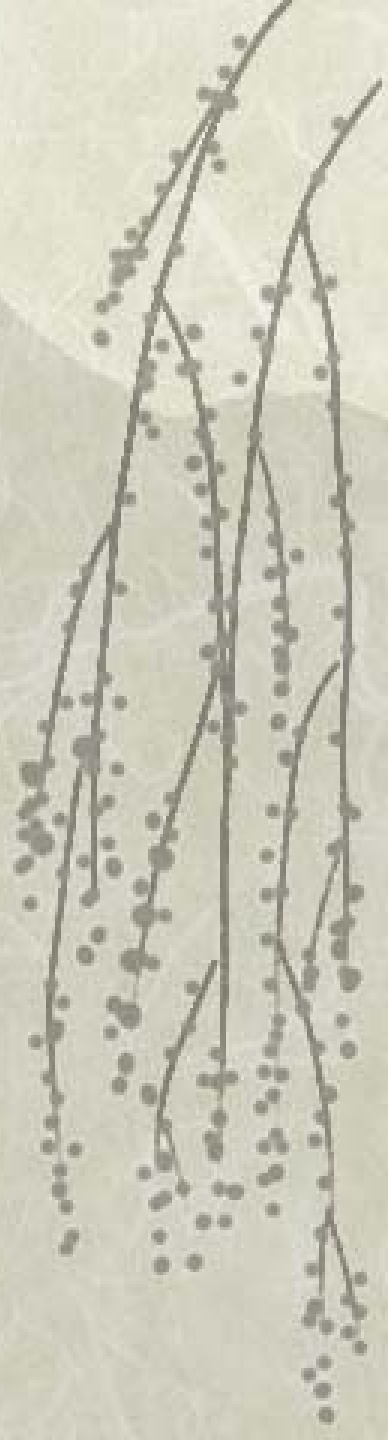
Sustainable Sites

Installation/Base Redevelopment - 1-2 Credits

Select sites close to existing roads and utilities or use an existing structure to minimize the need for new infrastructure (1 point).

TECHNOLOGIES/STRATEGIES:

During the site selection process give preference to previously developed sites with installation/base cantonment redevelopment potential such as facility reduction program cleared sites.



Sustainable Sites

Brownfield Redevelopment - 1 Credit

INTENT:

Rehabilitate damaged sites where development is complicated by real or perceived environmental contamination, reducing pressure on undeveloped land.

REQUIREMENT:

Develop on a site classified as a brownfield and provide remediation as required by EPA's Brownfield Redevelopment program requirements OR develop a site that has been contaminated by previous uses.

Sustainable Sites

Brownfield Redevelopment - 1 Credit

TECHNOLOGIES/STRATEGIES:

Screen potential damaged sites for these criteria prior to selection for rehabilitation.

Utilize EPA OSWER Directive 9610.17 and ASTM Standard Practice E1739 for site remediation where required.

Sustainable Sites

Alternative Transportation - 1-4 Credits

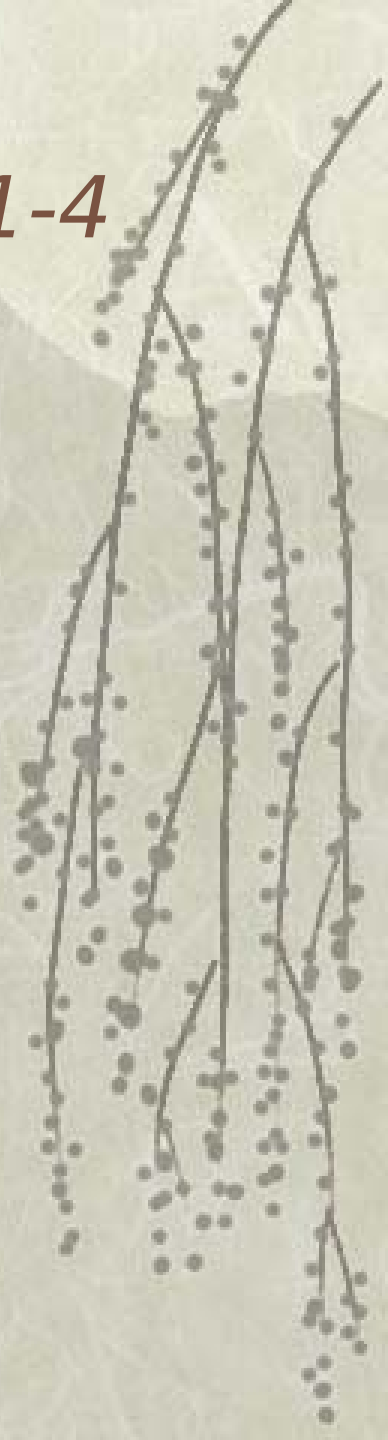
INTENT:

Reduce pollution and land development impacts from automobile use.

REQUIREMENT:

Locate building within ½ mile of a installation/base transit systems. (1 point)

Provide suitable means for securing bicycles, with convenient changing/shower facilities for use by cyclists, for 5% or more of building occupants. (1 point)



Sustainable Sites

Alternative Transportation - 1-4 Credits

REQUIREMENT (cont):

Locate building within 2 miles of alternative-fuel refueling station(s). (1 point)

Size parking capacity not to exceed minimum installation/base cantonment requirements AND provide preferred parking for carpools or van pools capable of serving 5% of the building occupants, OR, add no new parking for rehabilitation projects AND provide preferred parking for carpools or van pools capable of serving 5% of the building occupants. (1 point)

Sustainable Sites

Alternative Transportation - 1-4 Credits

TECHNOLOGIES/STRATEGIES:

Select sites near public or installation/base transit stops served by safe, convenient pedestrian pathways.
Consider sharing parking with other buildings and projects.

Sustainable Sites

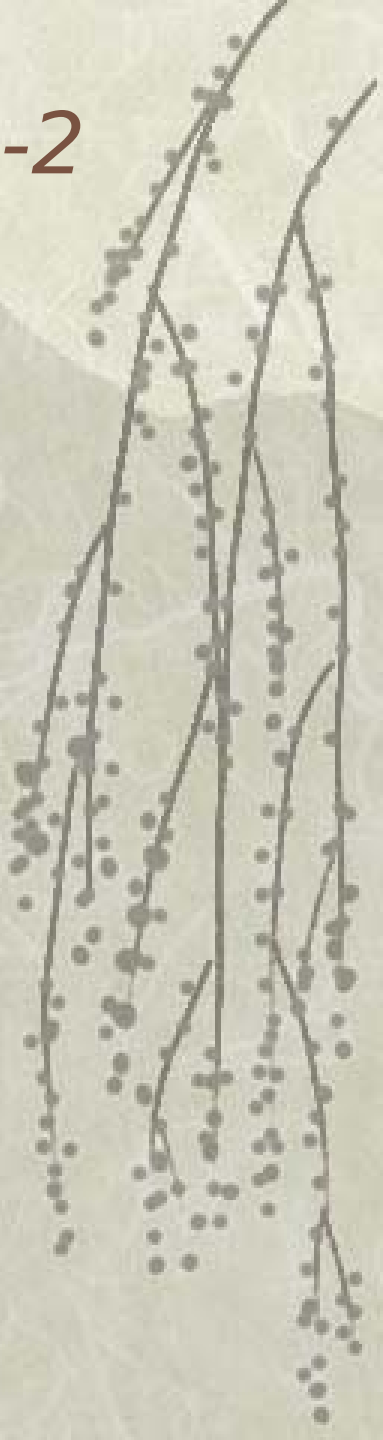
Reduced Site Disturbance - 1-2 Credits

INTENT:

Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

REQUIREMENT:

On greenfield sites, limit site disturbance including earthwork and clearing of vegetation to 40 feet beyond the building perimeter, 5 feet beyond primary roadway curbs, walkways, and main utility branch trenches, and 25 feet beyond pervious paving areas that require additional staging areas in order to limit compaction in the paved area;



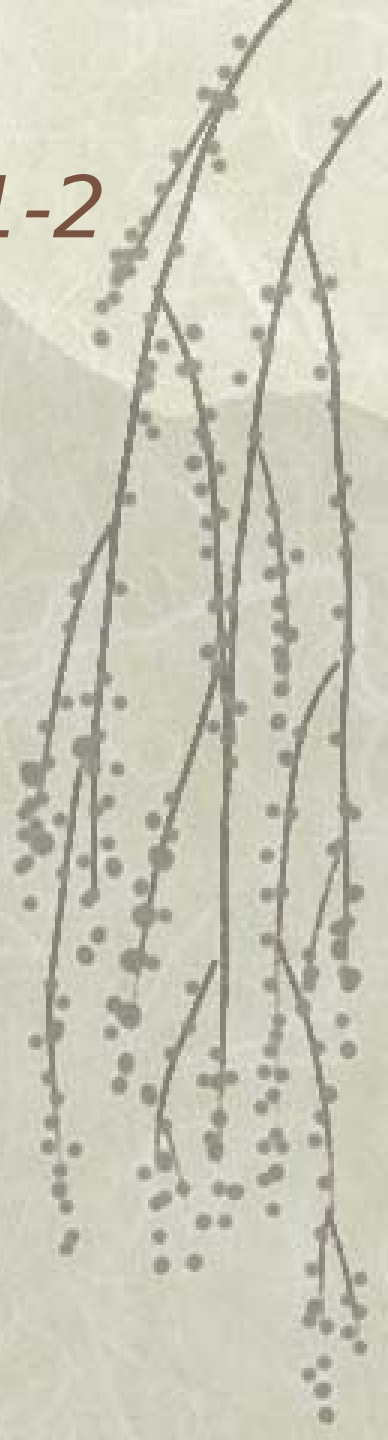
Sustainable Sites

Reduced Site Disturbance - 1-2 Credits

REQUIREMENT (cont):

OR, on previously developed sites, restore a minimum of 50% of the remaining open area by planting native or adapted vegetation. (1 point)

Reduce the development footprint (including building, access roads, and parking) to exceed the installation/base master plan's local open space requirement for the site by 25% or in accordance with installation/ base policy on open space set asides, whichever is greater. (1 point)



Sustainable Sites

Reduced Site Disturbance - 1-2 Credits

TECHNOLOGIES/STRATEGIES:

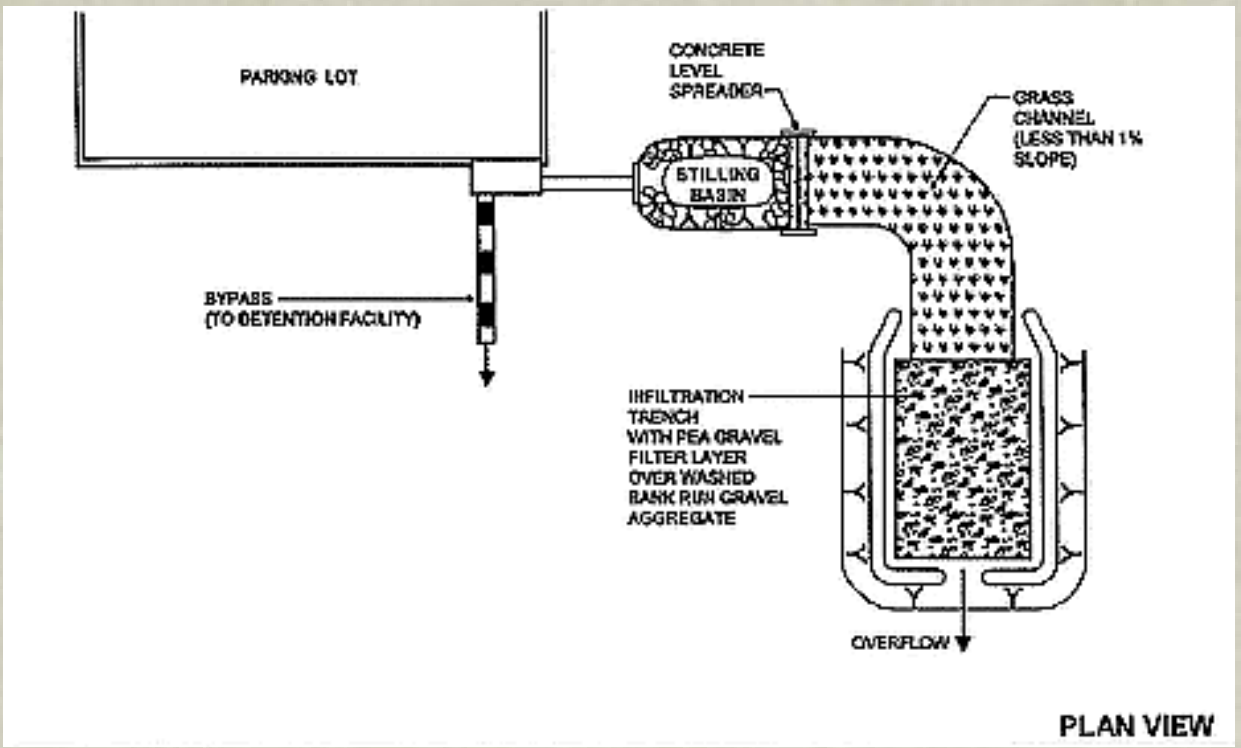
Note requirements on plans and in specifications. Establish contractual penalties for destruction of trees and site areas noted for protection. Reduce footprints by tightening program needs and stacking floorplans. Establish clearly marked construction and disturbance boundaries. Delineate laydown, recycling, and disposal areas. Use areas to be paved as staging areas. Work with local horticultural extension services, native plant societies, or installation agronomy staff to select indigenous plant species for site restoration and landscaping.

Sustainable Sites

Stormwater Management - 1-2 Credits

INTENT:

Limit disruption of natural water flows by minimizing storm water runoff, increasing on-site infiltration, and reducing contaminants.


PARKING LOT
CONCRETE LEVEL SPREADER
GRASS CHANNEL (LESS THAN 1% SLOPE)
STILLING BASIN
BYPASS (TO DETENTION FACILITY)
INFILTRATION TRENCH WITH PEA GRAVEL FILTER LAYER OVER WASHED BANK RUN GRAVEL AGGREGATE
OVERFLOW
PLAN VIEW

Sustainable Sites

Stormwater Management - 1-2 Credits

REQUIREMENT:

Implement a stormwater management plan that results in:

No net increase in the rate or quantity of stormwater runoff from existing to developed conditions; OR, if existing imperviousness is greater than 50%, implement a stormwater management plan that results in a 25% decrease in the rate and quantity of stormwater runoff. (1 point)

Sustainable Sites

Stormwater Management - 1-2 Credits

REQUIREMENT (cont):

Construct site stormwater treatment systems designed to remove 80% of the average annual post-development total suspended solids (TSS) and 40% of the average annual post-development total phosphorous (TP) based on the average annual loadings from all storms less than or equal to the 2-year/24-hour storm. Do so by implementing Best Management Practices (BMPs) outlined in Chapter 4, Part 2 (Urban Runoff), of the United States Environmental Protection Agency's (EPA's) *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (Document No. EPA-840-B-93-001c January 1993) or the local government's BMP document (whichever is more stringent). (1 point)

http://www.epa.gov/nps/MMGI/Chapter4/ch4-2a.html

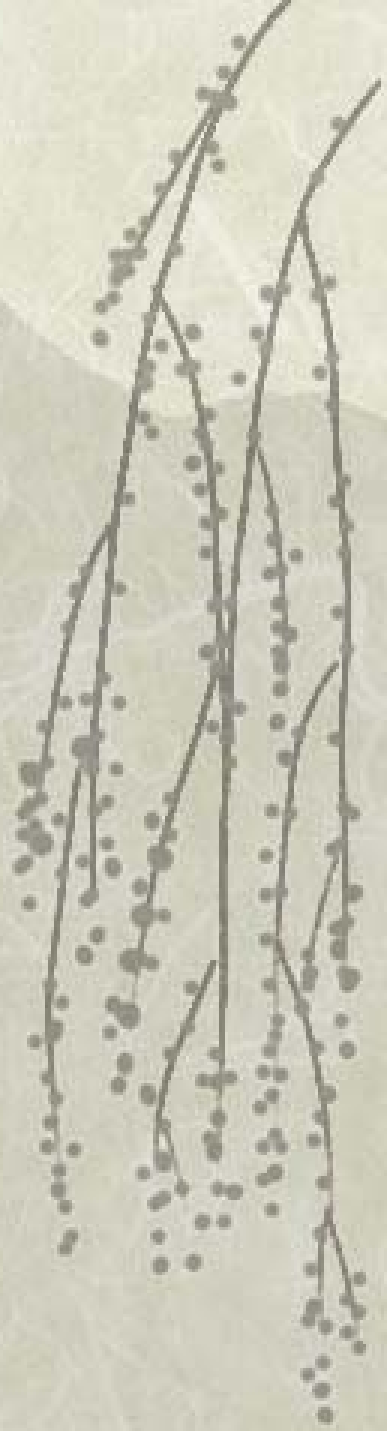
Sustainable Sites
Stormwater Management - 1-2 Credits

TECHNOLOGIES/STRATEGIES:

Significantly reduce impervious surfaces, maximize on-site stormwater infiltration, and retain pervious and vegetated areas. Capture rainwater from impervious areas of the building for groundwater recharge or reuse within building. Use green/ vegetated roofs. Utilize biologically-based and innovative stormwater management features for pollutant load reduction such as constructed wetlands, stormwater filtering systems, bioswales, bio-retention basins, and vegetated filterstrips. Use open, vegetated swales to reduce drainage velocity and erosion, reduce system maintenance, increase vegetative variety, and support wildlife habitat where space permits.

Sustainable Sites
Stormwater Management Techniques

BMPs	Runoff Prevention	Water Quality
Reduce Imperviousness	X	
Strategic Clearing/Grading	X	
Engineered Landscape	X	
Eliminate Curb and Gutter	X	X
Vegetative Buffers	X	X



Sustainable Sites

Stormwater Management - 1-2 Credits

BMPs	Detention	Retention	Conveyance	Water Quality
Bioretention	X	X		X
Infiltration Trench		X		X
Roof Top Storage	X			
Vegetative Filter Strips			X	X

Sustainable Sites

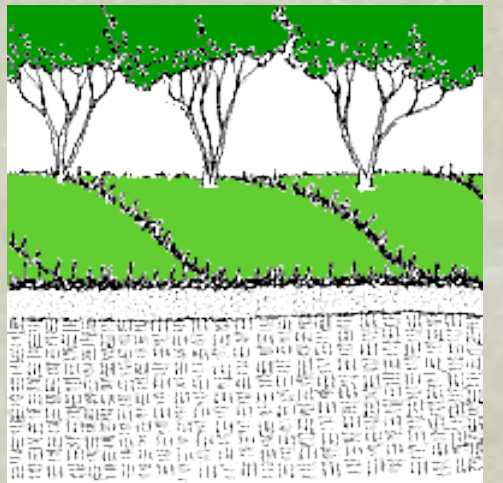
Stormwater Management - 1-2 Credits

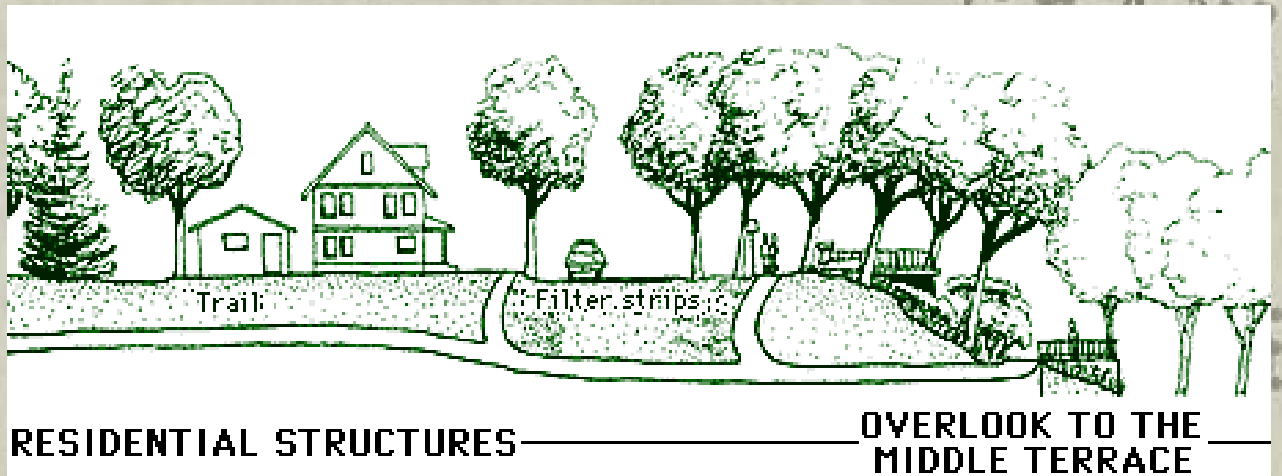
BMPs	Detention	Retention	Conveyance	Water Quality
Rain Barrels	X	X		
Swale and Small Culverts	X		X	X
Swales	X		X	X
Infiltration Swale	X	X	X	X

Filter Strips and Swales

Vegetated swale and recreation trail within a residential setting

Stormwater recreation trail.



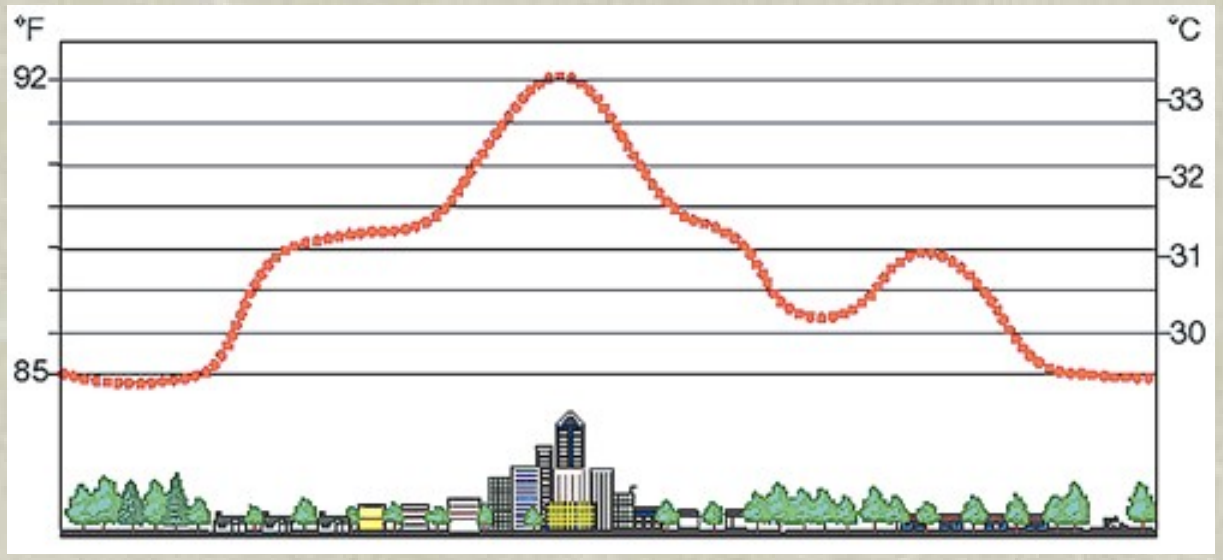


Sustainable Sites

Landscape and Exterior Design to Reduce Heat Islands - 1-2 Credits

INTENT:

Reduce heat islands (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitat.



Urban Heat Island Effect
Source: Lawrence Berkeley National Laboratory

Sustainable Sites

Landscape and Exterior Design to Reduce Heat Islands - 1-2 Credits

REQUIREMENT:

Provide shade (within 5 years) on at least 30% of non-roof impervious surface on the site, including parking lots, walkways, plazas, etc.,

OR, use light-colored/high-albedo materials (reflectance of at least 0.3) for 30% of the site's non-roof impervious surfaces,

OR place a minimum of 50% of parking space under-ground OR use open-grid pavement system (net impervious area of LESS than 50%) for a minimum of 50% of the parking lot area. (1 point)

Sustainable Sites

Landscape and Exterior Design to Reduce Heat Islands - 1-2 Credits

REQUIREMENT (cont):

Use ENERGY STAR Roof compliant, high-reflectance AND ~~low~~ high emissivity roofing (initial reflectance of at least .65 and three-year-aged reflectance of at least .5 when tested in accordance with ASTM E408) for a minimum of 75% of the roof surface;

OR, install a “green” (vegetated) roof for at least 50% of the roof area. (1 point)

Sustainable Sites

Landscape and Exterior Design to Reduce Heat Islands - 1-2 Credits

TECHNOLOGIES/STRATEGIES:

Employ design strategies, materials, and landscaping designs that reduce heat absorption of exterior materials. Note albedo/reflectance requirements in the drawings and specifications. Provide shade (calculated on June 21, noon solar time) using native or climate tolerant trees and large shrubs, vegetated trellises, or other exterior structures supporting vegetation. Substitute vegetated surfaces for hard surfaces. Explore elimination of blacktop and the use of new coatings and integral colorants for asphalt to achieve light colored surfaces.

Sustainable Sites

Landscape and Exterior Design to Reduce Heat Islands - 1-2 Credits

Technical Details on Roofing:

Use ENERGY STAR Roof-compliant, high-reflectance AND high emissivity roofing (for low slope roofs: initial reflectance of at least 0.65 and three-year-aged reflectance of at least 0.5 when tested in accordance with ASTM E903 and emissivity of at least 0.9 when tested in accordance with ASTM 408; for steep slope roofs: initial reflectance of at least 0.25 and three-year-aged reflectance of at least 0.15 when tested in accordance with ASTM E903 and emissivity of at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of the roof surface.

You can combine high albedo and vegetated roof providing they collectively cover 75% of the roof area.

Pervious Parking

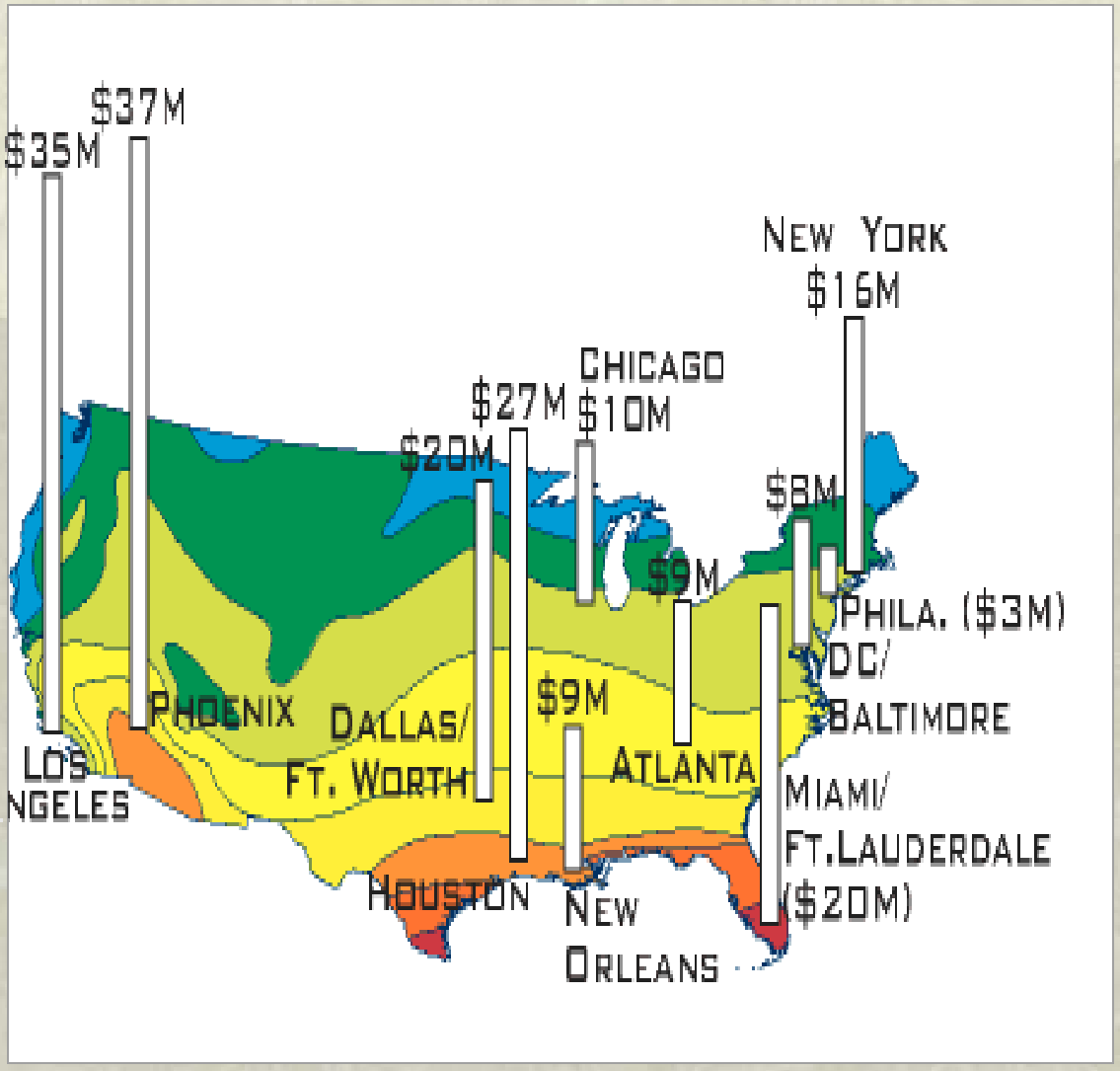
Grasspave:

- High load bearing
- Pollution filtration
- Cool surface
- $2.50/sf installed

Gravelpave

- Similar benefits
- Higher traffic

Cool Roofs



*Potential net energy savings from changing roof reflectivity. Savings are measured in dollars. Note that the **net** savings are the savings of cooling energy use less the penalties of heating energy use.*

Conventional roof options

Type of roof	Reflectance	Emittance	SRI	Cost ($/ft^2)
Built-up roof				**1.20–2.10**
With dark gravel	0.08–0.15	0.85–0.90	–2 to 13	
With smooth asphalt surface	0.04–0.05	0.85–0.95	–4 to 3	
With aluminum coating	0.25–0.60	0.20–0.50	–21 to 59	
Single-ply membrane				**1.00–2.00**
Black	0.04–0.05	0.85–0.95	–5 to 3	
Gray	0.15–0.20	0.85–0.95	10 to 21	
Modified bituem				**1.50–1.90**
With mineral surface capsheet	0.10–0.20	0.85–0.95	4 to 21	
Metal roof				**1.80–3.70**
Unpainted, corrugated	0.30–0.50	0.20–0.30	–12 to 32	
Dark-painted, corrugated	0.05–0.08	0.80–0.90	–6 to 4	
Asphalt shingle				**1.10–1.40**
Black	0.04–0.05	0.20–0.30	–7 to 0	
Brown	0.05–0.09	0.80–0.90	–6 to 5	
Liquid applied coating				**0.50–0.70**
Smooth black	0.04–0.05	0.85–0.95	–5 to 2	
Concrete tile				**3.00–4.00**
Red	0.10–0.12	0.85–0.90	4 to 9	
Clay tile				**3.00–4.00**
Red	0.20–0.22	0.85–0.90	16 to 22	
Cement tile				**3.00–4.00**
Unpainted, corrugated	0.18–0.22	0.85–0.90	14 to 22	

Cool roof options

Type of roof	Reflectance	Emittance	SRI	Cost ($/ft^2)
Built-up roof				**1.20–2.15**
With white gravel	0.30–0.50	0.80–0.90	27 to 58	
With gravel and cementitious coating	0.50–0.70	0.80–0.90	55 to 86	
Smooth surface with white roof coating	0.75–0.85	0.85–0.95	92 to 108	
Single-ply membrane				**1.00–2.05**
White	0.70–0.78	0.85–0.95	85 to 104	
Modified bituem				**1.50–1.95**
White coating over a mineral surface	0.60–0.75	0.85–0.95	71 to 94	
Metal roof				**1.80–3.75**
White-painted	0.60–0.70	0.80–0.90	69 to 86	
Asphalt shingle				**1.20–1.50**
White	0.25–0.27	0.80–0.90	21 to 28	
Liquid applied coating				**0.60–0.80**
Smooth white	0.70–0.85	0.85–0.95	85 to 108	
Smooth off-white	0.40–0.60	0.85–0.95	43 to 73	
Rough white	0.50–0.60	0.85–0.95	57 to 73	
Concrete tile				**3.00–4.00**
White	0.65–0.75	0.85–0.90	78 to 93	
With off-white coating	0.65–0.75	0.85–0.90	78 to 93	
Clay tile				**3.00–4.00**
Also classified as a cool roof alternative				
Cement tile				**3.00–4.00**
White	0.70–0.75	0.85–0.90	78 to 93	

Green Roofs

Underlying membrane exposed, primer application in process; Upper membrane torch application; Hyrdogel crystals under rows of white polyester fabric. Photos Courtesy

Green Roofs

Develop a custom soil mix as follows: 30% sandy loam; 15% compost; 40% coarse perlite; and 15% coconut coir. When saturated, the entire system, including soil and plants, weighs approximately 12-14 lb/sf. The plant list needs to conform to particular factors, including native origin; shallow root system; drought tolerance; availability; contribution of local fauna; and aesthetic value. Install native plants from 3" pots, cuttings, or broadcast seeds collected from the wild.

Sustainable Sites

Light Pollution Reduction - 1 Credit

INTENT:

Eliminate light trespass from the building site, improve night sky access, and reduce development impact on nocturnal environments.

REQUIREMENT:

Do not exceed Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the Recommended Practice Manual: Lighting for Exterior Environments, AND design interior and exterior lighting such that zero direct-beam illumination leaves the building site.

Sustainable Sites

Light Pollution Reduction - 1 Credit

TECHNOLOGIES/STRATEGIES:

Consult IESNA Recommended Practice Manual: Lighting for Exterior Environments for Commission Internationle de l'Eclairage (CIE) zone and pre and post curfew hour descriptions and associated ambient lighting level requirements. Ambient lighting for pre-curfew hours for CIE zones range between . 01 footcandles for areas with dark landscapes such as parks, rural, and residential areas, and 1.5 footcandles for

Sustainable Sites

Light Pollution Reduction - 1 Credit

TECHNOLOGIES/STRATEGIES (cont):

areas with high ambient brightness such as urban areas with high levels of nighttime activity. Design site lighting and select lighting styles and technologies to have a minimal impact off-site and minimal contribution to sky glow. Minimize lighting of architectural and landscape features. Exterior lighting should be consistent with security lighting requirements.

Sustainable Sites

Light Pollution Reduction - 1 Credit

Addtional Technical Information:

Meet or provide lower light levels and uniformity ratios than those recommended by the Illuminating Engineering Society of North America (IESNA) *Recommended Practice Manual: Lighting for Exterior Environments* (RP-33-99). Design exterior lighting such that all exterior luminaires with more than 1000 initial lamp lumens are shielded and all luminaires with more than 3500 initial lamp lumens meet the Full Cutoff IESNA Classification. The maximum candela value of all interior lighting should fall within the building (not out through windows) and the maximum candela value of all exterior lighting shall fall within the property. Any luminaire within a distance of 2.5 times its mounting height from the property boundary shall have shielding such that no light or brightness from that luminaire crosses the property boundary.

Light Pollution

Reduce night lighting needs:

- Limit to secure areas and/or install motion detectors
- Limit lighting to safe passage zones
- Control with timers

Proper cut-off angles - light should go down not up

Lighting fixture height - reduce height relative to boundary areas

The United States at Night

N O A A
Satellite photo revealing the estimated **30%** of all US outdoor lighting being directed skyward as waste. Conservatively estimated at **$1.5 billion dollars in wasted electricity** yearly, this 30% requires the burning of **6,000,000 tons of coal** each year to generate this electricity waste.
Estimated by the International Dark-Sky Association.

Light Pollution

Space Ship????

Space Needle, Seattle WA

Sustainable Sites

Optimize Site Features - 1 Credit

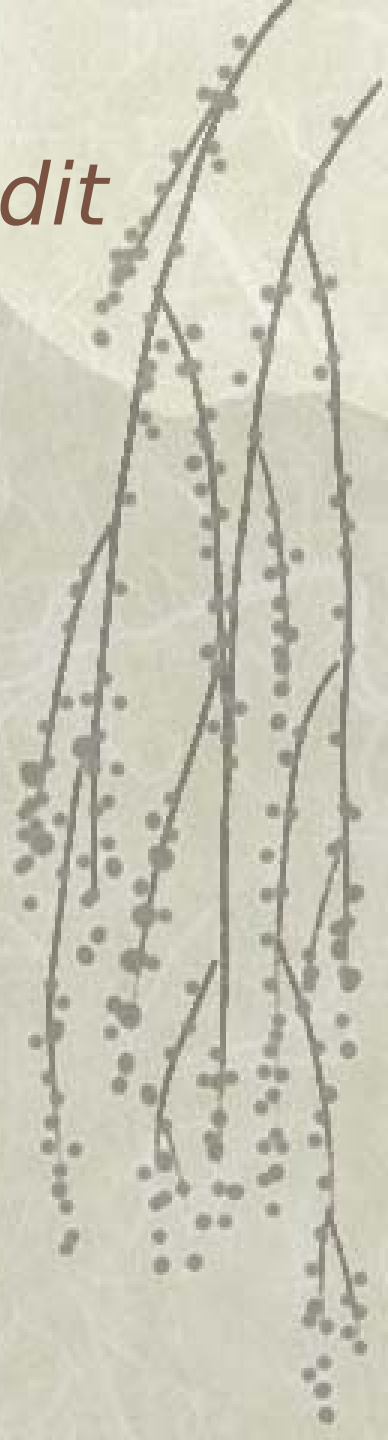
Intent:

Optimize utilization of the site's natural features and placement of man-made features on the site.

Requirement:

Perform both the following:

- Maximize the use of free site energy.
- Plan facility, parking, and roadways to "fit" existing site contours and limit cut and fill.



Sustainable Sites

Optimize Site Features - 1 Credit

TECHNOLOGIES/STRATEGIES:

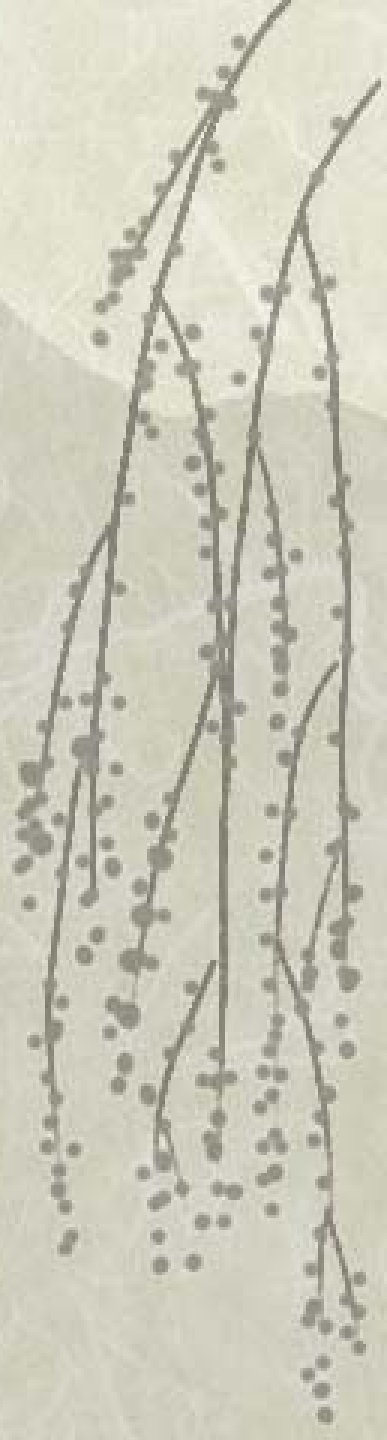
Evaluate site resources to ascertain how each can enhance the proposed project and visa versa. Work to maximum advantage of the site's solar and wind attributes. Use landscaping to optimize solar and wind conditions and to contribute to energy efficiency; Locate and orient the facility on the site to optimize solar and wind conditions.

Sustainable Sites

Facility Impact - 1-2 Credits

INTENT:

Minimize negative impacts on the site and on neighboring properties and structures; avoid or mitigate excessive noise, shading on green spaces, additional traffic, obscuring significant views, etc.



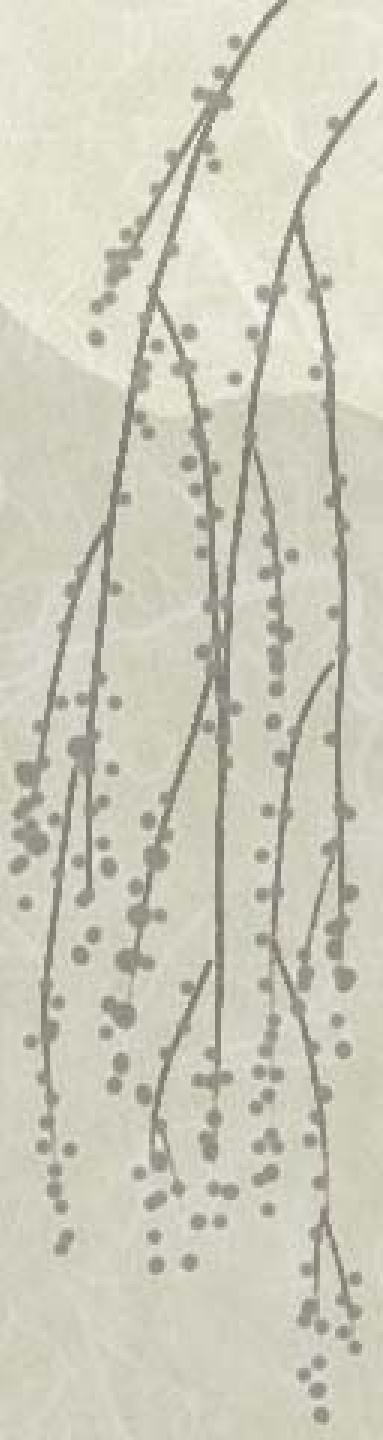
Sustainable Sites

Facility Impact - 1-2 Credits

REQUIREMENTS:

Cluster facilities to reduce impact, access distance to utilities and sufficient occupant density to support mass transit (1 point).

Collaborate with installation/base and community planners to identify and mitigate potential impacts of the project beyond site boundaries, and transportation planners to insure efficient public transport (1 point).



Sustainable Sites

Facility Impact - 1-2 Credits

TECHNOLOGIES/STRATEGIES:

Involve local/regional planners and community members in installation/ base master planning processes. Recognize the context and the impact of a project beyond site boundaries, and integrate it with the larger installation/base/community context/land use.

Sustainable Sites

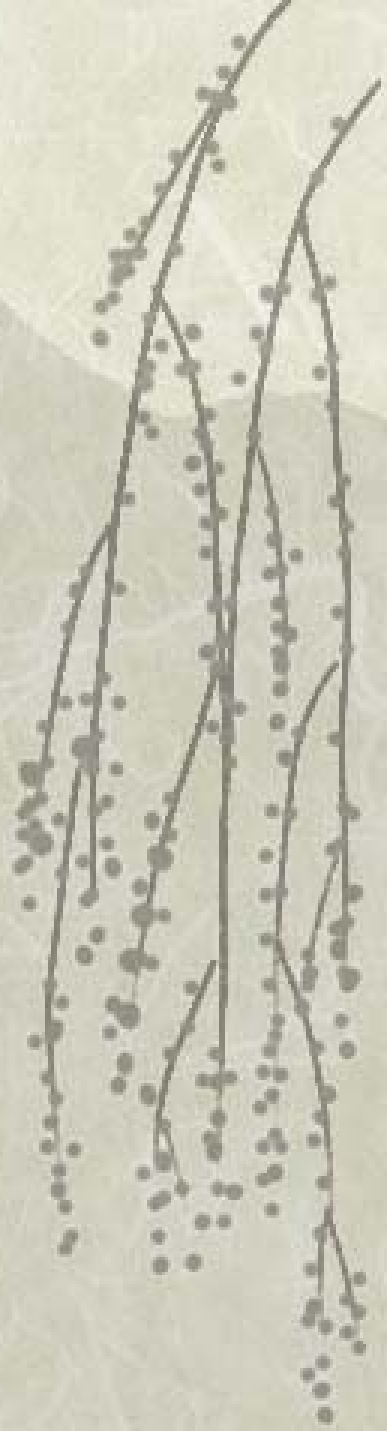
Site Ecology - 1 Credit

INTENT:

Identify and mitigate all existing site problems including contamination of soil, water, and air, as well as any negative impacts caused by noise, eyesores, or lack of vegetation, enhancing or creating new site habitat.

REQUIREMENT:

Develop site environmental management and mitigation plan.



Sustainable Sites

Site Ecology - 1 Credit

TECHNOLOGIES/STRATEGIES:

Understand site and surrounding ecosystem interdependence and interconnectivity. Plan landscaping scheme to incorporate biodiversity. Preserve/enhance existing trees, hydrological features, ecosystems, habitats, and cultural resources. Increase the existence of healthy habitat for native species. Reintroduce native plants and trees where they have been destroyed by previous development.

Web Sites for Sustainable Sites

http://eetd.lbl.gov/HeatIsland/

http://www.epa.gov/owow/nps/MMGI/

http://www.darksky.org/ida/index.html

http://yosemite1.epa.gov/estar/consumers.nsf/content/outdoorlights.htm